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Indian Standard

METHODS OF TESTS FOR MAN-MADE STAPLE FIBRES

PART 1 DETERMINATION OF LENGTH

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PART 1 DETERMINATION OF LENGTH

(*Clause* 4.1, *line* 3) — Substitute '24 hours' *for* '16 hours'.

(TX 01)

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PART 1 DETERMINATION OF LENGTH

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Indian Standard

METHODS OF TESTS FOR MAN-MADE STAPLE FIBRES

PART 1 DETERMINATION OF LENGTH

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Indian Standards Institution on 31 August 1984, after the draft finalized by the Physical Methods of Test Sectional Committee had been approved by the Textile Division Council.

0.2 In the preparation of this standard due weightage has been given to the testing practices followed in the country in this field. The 'oiled-plate method' is the preferred method in terms of accuracy. Method for determination of percentage of longer fibres has also been given in Appendix A for information, since this parameter is also used by the industry during process control in addition to the main method given in this standard.

0.3 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part 1) prescribes two methods for determination of the length and length distribution of man-made staple fibres.

2. PRINCIPLES

2.1 In Method A, the crimp of the individual fibres is removed and the fibres are straightened manually. The length of the fibres is measured against a scale on a sheet of glass oiled with liquid paraffin or any other suitable oil and the mean length is calculated. In Method B the mean length of tuft of fibres is determined by arranging the fibres length wise and analysing the staple diagram obtained

*Rules for rounding off numerical values (*revised*)

3. SAMPLING

3.1 The sampling shall be done according to the procedure given in IS : 4807-1968*.

4. ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

4.1 Prior to test, the test sample shall be preconditioned and then conditioned to moisture equilibrium in standard atmosphere at 65 $\pm$ 2 percent relative humidity and 27 $\pm$ 2°C temperature for at least 16 hours (*see also* IS : 6359-1971†).

5. METHOD A-1 OILED PLATE METHOD

5.1 Apparatus

5.1.1 *Transparent Glass Plate* — approximately 25 cm × 15 cm, on a black ground for uncoloured fibres and on contrasting ground for coloured fibres.

5.1.2 *Liquid Paraffin* — or any other suitable oil.

5.1.3 *A Piece of Velvet* — of contrasting colour with that of the fibres, stretched on a frame.

5.1.4 *A Pair of Tweezers* — fine enough to lift the fibres one by one.

5.1.5 *A Scale* — graduated to 1 mm.

5.2 Test Sample

5.2.1 Divide the gross sample into 16 equal parts. Take a small quantity of fibres from each of the sixteen parts so as to make a total of 50 g approximately. Mix it thoroughly. This shall constitute the test sample. From the test sample take small quantities of fibres from four different places so as to get about 3 000 fibres. The mass of the sample to yield about 3 000 fibres is determined according to the following formula:

$$\text{Mass (mg)} = \frac{\text{denier} \times \text{nominal length (mm)}}{3}$$

NOTE — This will yield approximately 3 000 fibres from the test sample thus prepared, the number of fibres for testing should be 250 and two tests be conducted.

5.3 Procedure

5.3.1 Using oiled plate, cover the glass plate (*see* **5.1.1**) with a thin layer of oil. Place the conditioned fibres one by one on the oiled plate. Straighten the fibres gently, care being taken not to remove the crimp permanently by over stretching. Two alternate methods are recommended as follows.

*Methods of testing viscose rayon staple fibres.
†Method for conditioning of textiles.

5.3.1.1 *Using the fingers*

Place the left end of the fibre on the reference line.

Place the index finger of the left hand on the left end of the fibre near the reference line; with the index finger of the right hand straighten out the fibre progressively by moving from left to right.

When the fibre is straightened over practically the whole of its length, the index finger of the left hand is lifted and replaced more to the right, slightly to the left of the point reached by the index finger of the right hand.

The index finger of the right hand completes the straightening and is lifted from the fibre. If crimped fibres are very stiff, a small amount of crimp may return and the contraction lead to a systematic error in the measurements. This error should be noted in the report of the tests, but it is always very small.

5.3.1.2 *Using small pointed wooden sticks*

Place the left end of the fibre on the reference line.

Keeping this end of the fibre in position with the pointed end of one of the sticks apply the pointed end of the other stick to the other end of the fibre and straighten out the fibre progressively by moving it to the right.

Read off the length of the one fibre when it has been fully straightened out between the pointed ends of the two sticks.

5.3.2 *Using Tweezers*

5.3.2.1 With a pair of tweezers in each hand, take the fibres, such that, one end of the fibre being held with one pair of tweezers, and the other end with the other pair.

5.3.2.2 Ensure that the ends of the fibre are just visible beyond the jaws of the tweezers.

5.3.2.3 Align the fibre end so visible beyond the jaws of the tweezers held in the left hand with zero mark on the scale and using the tweezers held in the right hand and straighten the fibre out along the scale against the background of the velvet, until any crimp just disappears. Care should be taken that no permanent reduction in crimp is caused by the tension applied in straightening the fibre to check this. The operator should verify periodically that the crimp returns fully when the tension is relaxed; in this way he shall acquire the necessary expertise, for each type of fibre to ensure that no more than the minimum tension needed to straighten out the fibre is ever applied.

5.3.2.4 When the fibre has been straightened in the manner described above, note the millimeter scale division which is closest to the fibre end which is just visible beyond the jaws of the tweezers held in the right hand. Note the results as the length of the fibre in millimetres.

NOTE — The measurement of the fibre lengths recorded can be strongly influenced by the decrimping operation and by any excessive stretching. The quality of the operator's work and the accuracy of the lengths reported should be checked, for instance by placing a certain number of fibres between two glass plates and measuring their lengths precisely with the aid of an enlarger and a map-measurer before determination according to the relevant procedure.

5.4 Method A-2 Cello-Tape Method

5.4.1 *Apparatus*

a) *Transparent cello-tape*

b) *Scissors or blade*

c) *Table with contrasting coloured surface*

d) *A scale graduated in millimetres.*

5.4.2 *Procedure* — Take about 300 fibres as in **5.1.2.1**. Take two small bits of cello-tape and with the left hand place one end of the fibre on the cello-tape taking care to see that not more than 1 to 2 mm is gripped. Then with the right hand take the other end of the fibre and put it on the cello-tape again taking care to see that only 1 to 2 mm fibre is on the cello-tape. Fix both the cello-tape bits on the table such that the fibre crimps are removed as shown in Fig. 1. With the help of a scale measure the length of the fibre from tip to tip, since the cello-tape is practically transparent, the whole length of fibre is visible.

NOTE — Apply just sufficient tension to remove crimp from the fibres otherwise the fibre may slip from the tapes.

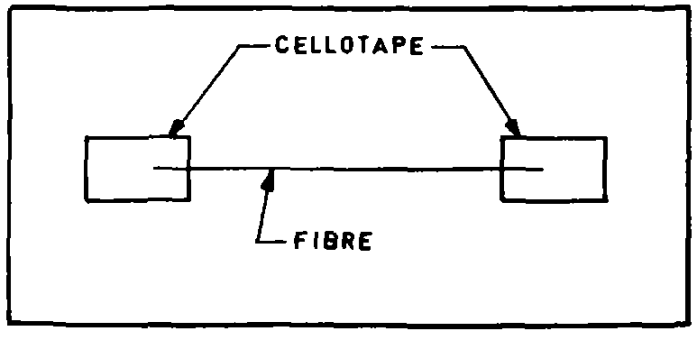


FIG. 1 FIBRE FIXING BY CELLO-TAPE METHOD

5.4.2.1 Record the length (mm) of all the fibres.

5.5 Calculation

5.5.1 *Mean Length, Standard Deviation and Co-efficient of Variation* — Group the individual length values in classes with class interval of 1 mm for a nominal length less than 45 mm, 2 mm for nominal length between 46 and 80 mm, and 5 mm for a nominal length above 80 mm. The middle point of the class interval, denoted by (L_i) shall be taken to be the length of each fibres in that class. Let n_i denote the number of fibres in the 1st class. The mean fibre length, standard deviation and co-efficient of variation shall be calculated by the following:

$$\text{Mean length } (\bar{L}) = \left[\frac{\sum_{i=1}^{k} n_i L_i}{\sum_{i=1}^{k} n_i} \right]$$

where k is number of classes

$$\text{Standard deviation } (\sigma_L) = \sqrt{\frac{\sum_{i=1}^{k} n_i (L_i - \bar{L})^2}{\left\{ \sum_{i=1}^{k} n_i \right\} - 1}}$$

$$\text{Co-efficient of variation (CV) percent} = \left[\frac{\sigma_L}{\bar{L}} \times 100 \right]$$

5.5.2 *Modal Length* — Find out the class interval for which the number of fibres n_i is maximum. The middle point of this class interval shall be taken as the modal length.

5.5.3 Carry out two tests according to **5.3** and calculate parameters as per **5.4** for these tests. Determine average values of each parameters.

5.6 Report

5.6.1 The report shall include the following information:

a) Mean length (mm) rounded off to one decimal place,

b) Standard deviation rounded off to two decimal places,

c) Co-efficient of variation rounded off to two decimal places, and

d) Modal length rounded off to one decimal place.

6. METHOD B ARRAY METHOD

6.1 Apparatus

6.1.1 *Staple Fibre Sorter and Accessories — See* Fig. 2.

6.1.2 *Velvet Plush*

6.1.3 *Pair of Tweezers*

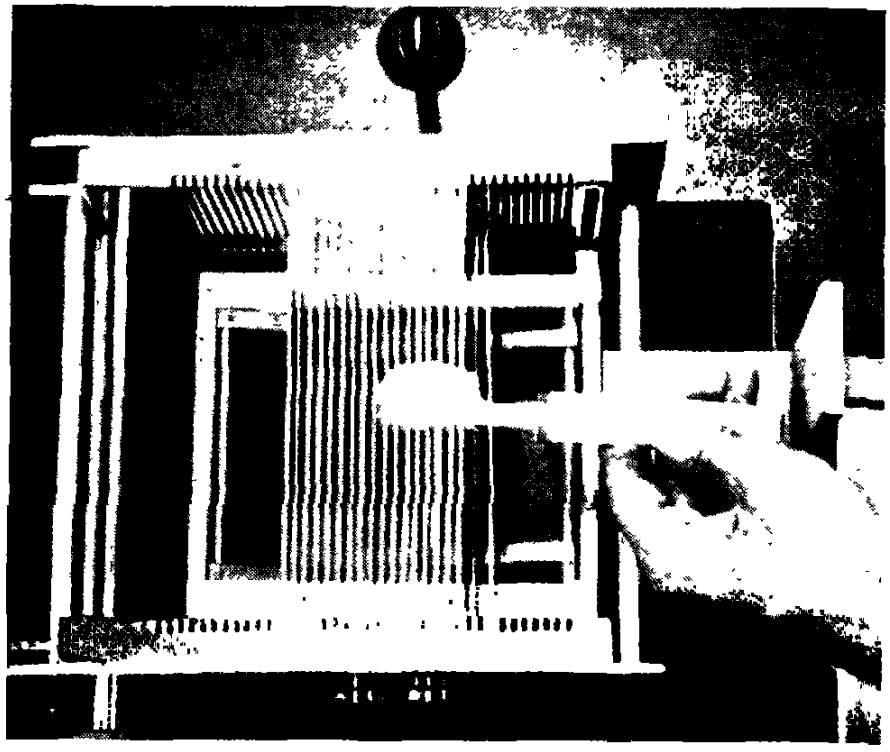


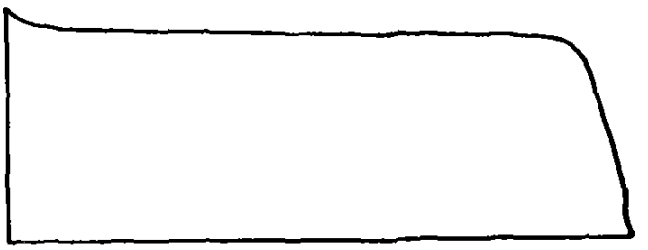
FIG. 2 A TYPICAL STAPLE FIBRE SORTER

6.2 Test Specimen

6.2.1 Take the specimen of about 200 to 500 mg depending on the denier.

6.3 Procedure

6.3.1 Weigh the specimen accurately and parallelize with a metal comb. Prepare the fibre array diagram of approximately 25 cm width with comb sorter according to Part 2 of IS : 233-1978* as shown in Fig. 3.



VISCOSE STAPLE FIBRE (40 mm < 3% SHORT FIBRES)

FIG. 3 TYPICAL FIBRE ARRAY DIAGRAM

6.4 Calculation

6.4.1 *Method 1 — Staple Diagram Method* — Divide the staple diagram prepared by the above procedure into 50 fibre length groups, and measure the fibre lengths on both the boundary lines of each section. Calculate the mean fibres length (L_A) as follows:

$$\text{Mean length } (L_A) = \left[\frac{49 \text{ boundary fibre lengths} + \text{average of both end fibre lengths}}{50}\right]$$

6.4.2 *Method 2 — Compensated Staple Fibre Diagram Method* — After obtaining the mean fibre length (L_A) as per **6.4.1**, draw randomly one fibre from each of the 10 straightline portions on the plate and measure its length by holding down its one end and straightening it with finger tips. Calculate the mean length as follows:

$$\text{Mean length } (L_B) = \left(\frac{L_o}{L} \times L_A\right)$$

where

L_o = mean length of 10 fibres, and

L = mean length of the same 10 fibres from the staple diagram.

*Methods for determination of length parameters of cotton fibres : Part 2 Estimation of length and length distribution by the array method (*first revision*).

6.4.3 Carry out two tests, and calculate parameters as per **6.4.** Determine the average value of required parameters.

6.5 Report

6.5.1 The report shall include the following information:

a) Mean length (mm) rounded off to one decimal place, and

b) Percent longer fibres (*see* Appendix A).

APPENDIX A

(*Clauses* 0.2 *and* 6.5.1)

DETERMINATION OF PERCENT LONGER FIBRES

A-1. PRINCIPLE — The fibres exceeding the rated length by more than 10 mm are termed as ' longer fibres '. The percentage of longer fibres is the ratio of the longer fibres to the total number of fibres multiplied by 100.

A-2. APPARATUS

A-2.1 Staple Fibre Sorter (*see* Fig. 2) and Accessories— (adjustable stop, depressor, special fibre grip or tweezers).

A-2.2 Black Velvet Plush

A-2.3 A Scale Graduated— in millimetres.

A-2.4 Analytical Balance — graduated in milligrams.

A-3. TEST SAMPLE

A-3.1 Take a fibre bundle from a representative sample comprising about 30 000 fibres. The mass of the sample to yield about 30 000 fibres is calculated from the formula:

$$\text{Mass (mg)} = 3\,3 \times \text{nominal length (mm)} \times \text{denier}.$$

A-3.2 Parallelize the fibres by hand and divide the sample into bundle of 100 to 150 mg.

A-4. PROCEDURE

A-4.1 Place the bundle in the maximum decrimped condition in the gill section of the sorter.

A-4.2 Drop the gill pins until the first set of fibre protrude beyond the remaining gill section.

A-4.3 Set the step opposite the first gill pin to the distance given by the following formula:

$$\text{Distance (mm)} = \text{length (mm) of grip} + \text{nominal length (mm) of fibres} + 8 \text{ mm}$$

A-4.4 Pull the fibres using the grip upto the stop. The longer fibres will remain in gill even after taking grip upto the stop. Remove these fibres and lay them on velvet plush. Confirm the longer fibres by measuring their length with a scale.

A-4.5 Having pulled all the fibres projecting beyond the gill section, lower the first gill, set the stop to the next gill and repeat the procedure. Continue this procedure until the fibre tuft remaining in the gill section is smaller than the rated length plus 10 mm.

A-5. CALCULATION

A-5.1 Total number of fibres $= \left(\frac{W \times 9\,000}{L \times d} \right)$

where

W = mass (mg),

L = rated length (mm), and

d = denier.

A-5.2 Percent longer fibres $= \left(\frac{\text{Number of longer fibres}}{\text{Total number of fibres}} \times 100 \right)$

(*Continued from page* 2)

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